

NITROGEN

Occurrence: Occurrence of nitrogen in soil means how the nitrogen is present in the soil. i.e. Whether it is present in ionic form or as NH_4^+ , NO_3^- or other forms.

Forms of Nitrogen: N is present in soil in many different forms. However, the following are main forms :-

1) Gaseous form:

- a. Elemental nitrogen (N_2).
- b. Nitric oxide (NO).
- c. Nitrous oxide (N_2O).
- d. NO and N_2O are present only in trace amounts. NH_3 is also present in trace amount but notable.

2) Inorganic ionic forms:

- a. Ammonium (NH_4^+).
- b. Nitrate (NO_3^-).
- c. Nitrite (NO_2^-).

3) Inorganic compound:

Besides different salts of ammonium and nitrate in the combined stage, N_2 may be found in nitre, chile saltpeter and NH_3 .

4) Organic forms:

- a. Proteins.
- b. Consolidated amino acids.
- c. Neoproteins.
- d. Free amino acids.
- e. Amino sugars.
- f. Other complex products form due to -
 - i. Reaction between ammonium and Lignin.

- ii. Polymerization of Quinine and N₂ compound.
- iii. Condense between sugars and amines etc.

5) Available forms:

- a. Nitrate (NO₃⁻).
- b. Nitrite (NO₂⁻).
- c. Ammonium (NH₄⁺).

Mineralization

Mineralization is the conversion process of organic form to mineral form or available form.

Two steps of N- Mineralization. These are-

- 1. Aminization.
- 2. Ammonification.

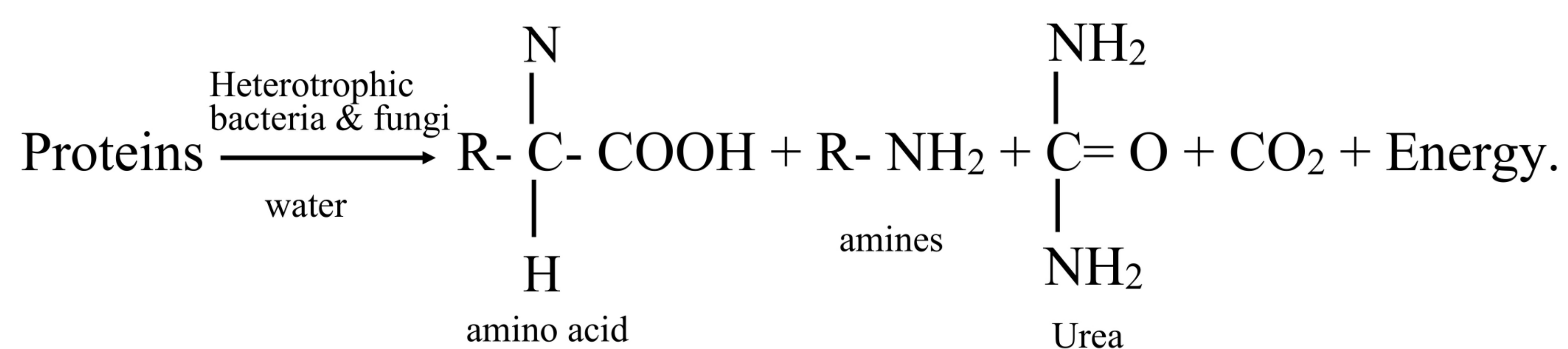
1. Aminization

The bacterial conversion or reduction process of organic N to amines or amino acids is called Aminization.

Or,

The biochemical decomposition of protein from organic matter and release of amino acids, amines, amides and other nitrogen (N) containing compounds by the effect of heterotrophic bacteria and fungi is termed as Aminization.

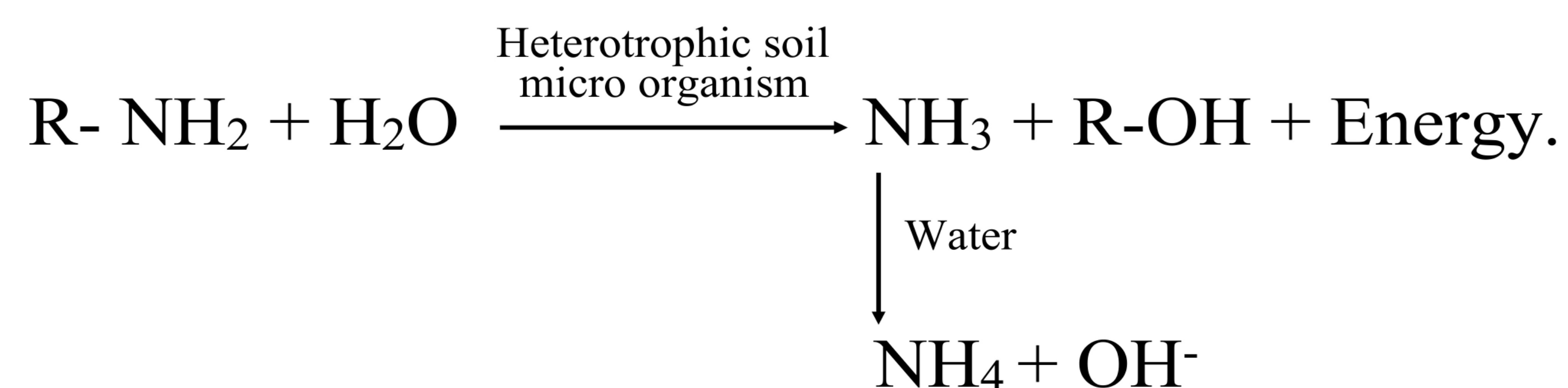
Heterotrophic bacteria and fungi are responsible for one or more steps in the reaction of organic matter decomposition. Bacteria break down protein in neutral and alkaline condition. Fungi break down protein under acidic condition. One of the final stage in decomposition of protein & the release of amines, amino acid and urea. This step is termed Aminization and represented as follows-



2. Ammonification

The biochemical decomposition of amino acids, amines, amides and urea produced by Aminization (effect of some groups of heterotrophic microbes) of organic nitrogen and release of NH_4^+ is termed as Ammonification. Heterotrophic soil micro organism are responsible for Ammonification of organic nitrogen.

The reaction are as follows -



Fates of NH_4^+

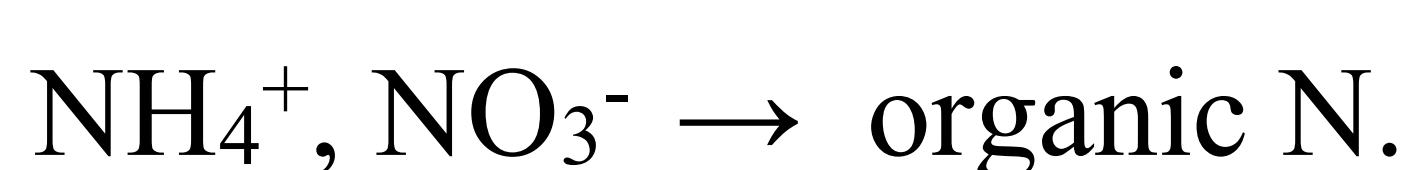
A very adverse population of aerobic and anaerobic bacteria, fungi and actinomycetes is capable for lebarating NH_4^+ is subject to several fates:

- i. Nitrification.
- ii. Absorbed by higher plants.
- iii. Heterotrophic micro organism (organic carbon residues).
- iv. Clay fixation.
- v. NH_3 volatilization.

Immobilization

The biochemical conversion of an element from inorganic form to organic form is called Immobilization. It is an assimilatory process.

Reaction:



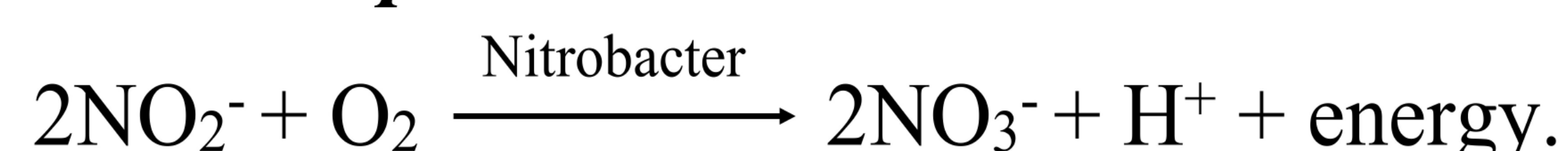
Nitrification

The biochemical oxidation of NH_4^+ to NO_3^- by certain group of autotrophic and heterotrophic bacteria is termed as Nitrification. It takes place in two co-ordinate steps-

First step:



Second step:



It has been also found that various heterotrophic organism, bacteria, actinomycetes, fungi are capable of converting nitrogenous compound to nitrite, various genera like nitrosomonas, nitrosolobus, nitrospira have been isolated from different types of soil. But soil receiving FYM and other animal excreta respective microorganism like nitrosomonas, nitrosolobus are found. Nitrosolobus plays a much more significant part in coming out the Nitrification processes in soils. Nitrite is quickly converted to 2NO_3^- (Nitrate).

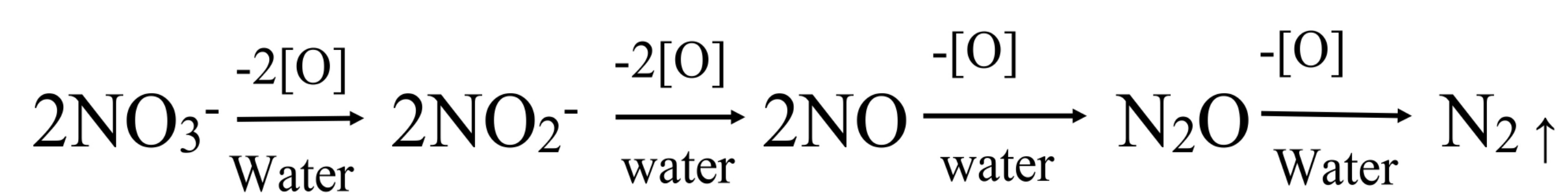
Nitrite accumulation

Both steps are obligatory aerobic. Therefore in water log soil, the oxidation of NH_4^+ is such restricted. In addition, the nitrifying bacteria acts in soil having neutral and slightly acidic condition. Under strongly acidic condition, the activity of these microorganism have been found to be depressed with simultaneous reduction of NH_4^+ oxidation.

NO_2^- accumulation occurs in toxic, pudding, calcareous condition. Nitrite accumulation toxic in water log soil.

Denitrification

It is the biochemical reduction of nitrate to gaseous compounds losses under anaerobic condition by heterotrophic, bacillus, pseudomonas etc.



Conditions of Denitrification

- i. Available NO_3^- .
- ii. Denitrifying organism must be present in soil.
- iii. Electron donor or organic carbon must be present in soil.
- iv. Sudden flooding.

Difference between Mineralization and Immobilization

Mineralization	Immobilization
1. The biochemical conversion of an elements from organic form to inorganic form is called mineralization.	1. The biochemical conversion of an elements from inorganic form to organic form is called Immobilization.
2. It is oxidation-reduction process.	2. It is assimilatory process.
3. Through Mineralization element become available to the plant.	3. Through Immobilization elements become unavailable to the plants.
4. It is beneficial process to the plant.	4. It is not beneficial to the plant.
5. <u>Reaction:</u> Organic N \rightarrow NH_4^+ , NO_3^-	5. <u>Reaction:</u> NH_4^+ , $\text{NO}_3^- \rightarrow$ Organic N

Difference between Nitrification and Denitrification

Nitrification	Denitrification
1. It is the biological oxidation of ammonium ions to nitrates.	1. It is the biochemical reduction of nitrate to gaseous compound or N_2 .
2. It is a step of organic matter mineralization.	2. It is the process of loss of N from soil which may be 2 types- a) Assimilatory b) Dissimilatory.
3. It is occurred in aerobic condition of soil.	3. It is occurred in anaerobic condition of soil.
4. The process is mediated by nitrosomonas and nitrobacter.	4. The process is mediated by heterotrophic. e.g. pseudomonas, bacillus etc.
5. Mechanism: <u>First step:</u> $2\text{NH}_4^+ + 3\text{O}_2 \rightarrow 2\text{NO}_2^- + 2\text{H}_2\text{O} + 4\text{H}^+ + \text{Energy}.$ <u>Second step:</u> $2\text{NO}_2^- + \text{O}_2 \rightarrow 2\text{NO}_3^- + \text{H}^+ + \text{energy}.$	5. Mechanism: $2\text{NO}_3^- \rightarrow 2\text{NO}_2^- \rightarrow 2\text{NO} \rightarrow \text{N}_2\text{O} \rightarrow \text{N}_2 \uparrow$